

WASHINGTON

SCIENCE TRENDS

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Space Reorganization - Again

The Pentagon's latest stop-gap attempt to define long-range roles and missions in the burgeoning space field may - contrary to most published opinion - strengthen rather than weaken the Army and Navy position in future space projects. But it will also bring a closer examination of existing and new programs on all levels, since the services must now include many costly programs within their own budgets.

ARPA's Future: No one in the services seriously expects to see the Advanced Research Projects Agency in existence longer than another year or two. The Defense Department agency has now come close to living up to promises that it would leave "hardware" programs to the individual services so that it could concentrate on materials, propulsion and other advanced technology studies. However, many of these programs are already being administered by other service and civilian agencies and there will undoubtedly be new demands that ARPA be abolished.

Space Boosters: Defense Secretary Neil McElroy has made it plain that the Air Force will develop and control the military space booster program, giving rise to speculation that this makes the Air Force the Space Force. However, this gives the Air Force little or nothing in the way of new "hardware" beyond the Atlas-Titan-Dynasoar programs which it has already, plus the Army-built Saturn, which it was expected to control. The Air Force's new responsibilities in space, one official of another service predicts, will last about 120 seconds - about the time it takes to get the boosters off the ground.

Space Payloads: More important, in the long-range view, is the fact that McElroy and the Administration have been won over to the Army and Navy view that control of the payload is of most significance. The Army, under the new arrangement, develops and controls communication satellites while the Navy has the same authority on navigation payloads - both of which the Air Force wanted but failed to obtain. Air Force does control missile-warning and reconnaissance payloads, as expected.

Missile Projects: Almost as important is the fact that the Navy retains control of the Polaris - thereby opening the way for control of sea-borne satellite and space launchings. Army keeps control of the Pershing intermediate range ballistic missile, which it was fearful of losing - thereby keeping its role in the long-range surface to surface missile field.

Meteor Burst Communication

A three-year investigation for the Air Force Cambridge Research Center leads the National Bureau of Standards to conclude that intermittent meteor burst communication can compete effectively with other long-distance systems and is relatively free from ionospheric disturbances which affect communication in the high frequency range.

- * Basic Principle: System is based on the trail of electrons and ionized atoms caused by the fall of meteors into the lower part of the ionosphere. Meteor trails cannot be used continuously to transmit signals because of their transient nature. Therefore, the need arose for a communication system which could operate intermittently at very high speed and could go into operation automatically when a suitable meteor trail is available. Provision for message storage was also required.
- * Meteor Burst Vs. Ionospheric Scatter: NBS points out that ionospheric forward scatter propagation provides a continuous signal, thereby easing transmission problems. However, the Bureau believes that meteor burst systems have the advantage of lower power and smaller antenna requirements, a wider usable spectrum and greater security in message transfer. In addition, there is less jamming and interference caused by reception of signals from other transmitters because of the highly directive character of the system.
- * System Operation: Two magnetic tape recorders handle the storage of incoming and outgoing messages at each of the transmitting-receiving stations. Teletype messages are recorded at high speed and then printed at normal speed.

Control equipment determines when conditions are acceptable for transmission of messages. This is based on the amplitude-versus-time characteristics of the received signal; the availability of storage space for incoming messages and the availability of messages for transmission.

Both transmitters are kept in continuous service and the system can therefore detect the presence of a suitably located meteor trail within a few thousandths of a second. Transmitters are commercial units intended for base station use in mobile communication service, operating at 49 megacycles with a power output of 2 kilowatts. When either station "hears" a signal reflected by a meteor trail, it shifts its transmitting frequency, indicating to the other its readiness to transmit messages.

The two stations "agree" to stop transmissions temporarily whenever either terminal runs out of magnetic tape, or the signal strength falls too low. Obvious error in received messages also causes a halt.

The system's receivers are double-conversion superheterodynes containing an FM detector for messages and an AM detector to measure signal strength. With each change in speed-up ratio, the transmitter frequency shift is changed and a filter sets the receiver pass band to correspond to the modulation. Another filter rejects signals from the system's adjacent transmitter. The antenna system is composed of two arrays, each consisting of two five element Yagi antennas. One array is used for receiving and the other for transmitting.

* Operating Performance

System was designed for a study of two-way communications over paths from 400 to 1200 miles in length. Tests were made over paths of 390 and 800 miles. Performance varied considerably with equipment settings and atmospheric conditions. In one case there was an error rate of only .004 percent at 30 words per minute. However, under the most adverse conditions of thunderstorm and precipitation static there was an error rate over 10 percent. The Bureau says it appears to be advantageous to operate intermittently at transmission speeds higher than the average signalling rate. Analysis of other data indicates that error rates can be reduced significantly by rejecting certain portions of the meteoric signals.

Most efficient operation appears to be at 2400 words per minute, which is about 40 times normal teletype speed. At this speed, and a suitable operating threshold setting, a daily average of 40 words per minute may be expected - at a character error rate of .35 percent, according to the NBS studies.

Bureau believes that higher transmission rates should give better results if improved controls systems and rapid access storage facilities can be substituted. Probability of error is increased at lower transmission rates, it is pointed out, because signals have to remain error-free for a longer period of time.

The experiments indicate to NBS that signals from two coexistent meteor trails occur frequently enough to be a serious source of error. Other sources of interference include electrical storms, precipitation static, nearby ignition systems, power lines, ionospheric forward scatter, sporadic E-layer propagation, and at the higher latitude installations, auroral reflected signals. Over short paths, 100 to 200 miles in length, tropospheric scatter signals are a problem. To avoid these sources of interference, the Bureau recommends that a practical meteor burst system contain an automatic device for setting the system's threshold at a fixed margin above the short-term median signal strength.

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Tungsten Development

Researchers at the Rolla, Mo. laboratories of the U.S. Bureau of Mines have succeeded in capturing high-purity tungsten from a mixture of gases, simultaneously forming the material into simple shapes. The method is said to make feasible the plating of high-purity tungsten onto various surfaces thus greatly extending the metal's usefulness, both in the missile and rocket field and in the chemical and metal-refining industries.

Low-temperature vapor deposition process is used. Pure tungsten metal is extracted from a mixture of tungsten hexafluoride and hydrogen gases by passing the metal over a heated metal surface. At the Rolla laboratory, the gas is pumped through a copper tube heated to about 1,100°F. which is hot enough to make the tungsten drop out of the gas stream as a metal. Impurities do not respond to this temperature and so remain in the gas which passes out of the tube.

The tungsten metal builds up on the tube walls in much the same way as carbon accumulates inside an automobile exhaust pipe. Copper is later stripped off, leaving the tungsten already formed into a useful shape.

Vibration Pickup Calibration Service

National Bureau of Standards has established a vibration pickup calibration service to aid industrial and Government laboratories in the testing of missiles, rockets, aircraft and other structures.

Calibration service previously available only on a limited basis, can now be employed for the ranges of 10 to 2,000 cps at accelerations up to 10 g. The Bureau can also perform dynamic calibrations between 2,000 and 20,000 cps, using a different method and different equipment.

Service in the lower ranges was formerly provided by a vibration standard consisting of a commercial electrodynamic exciter calibrated by the reciprocity method. This standard was then modified for routine application.

Currently, the errors in motion applied to pickup do not exceed 1 percent up to 900 cps and 2 percent between 900 and 2,000 cps. When a pickup is supplied without an indicator or recorder, the Bureau determines the magnitude and phase angle of the calibration factor. Calibrations are made at 3 different accelerations at 10 different frequencies, for a total of 30 calibration points. Dynamic calibrations are also made from 10 to 15 cps at double displacement amplitudes up to half an inch.

(Service available at standard fees through Mechanics Division, National Bureau of Standards, Washington 25, D.C.)

Industrial Laboratory Guide

National Academy of Sciences will publish a new edition of its Directory of Industrial Research Laboratories of the United States in mid-1960. Questionnaires are now being mailed out to organizations engaged in industrial development work on processes and products as well as fundamental and applied research. Laboratories concerned primarily with routine testing and control, but conducting research activities, will also be listed.

(Research organizations desiring to be listed may write Walter M. Whitlow, Editor, Industrial Research Laboratories, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington 25, D.C. if they have not received a questionnaire by Nov. 5, 1959. There is no charge.)

Surplus Sales

Quartz Crystal - General Services Administration plans to sell approximately 1,500,000 pieces of partially processed quartz crystal in the form of slabs, wafers and blanks. The electronic-grade crystals will be offered on a competitive basis early in 1960. A full description of the sale plan and materials offered will be set forth in a booklet to be issued in several months.

Rare Earth Materials - GSA plans to dispose of approximately 3,060 short wet tons of rare earth material through negotiated sale to commercial users. The material is a by-product of a chemical process used in the production of columbium-tantalum pentoxide. All 14 rare earth elements as well as thorium and yttrium are present.

(Further information available from Mr. George K. Caston, Defense Materials Service, General Services Administration, Washington 25, D.C.)

Research Checklist

() New Plasticizers: Agriculture Department scientists have developed new plastics that will bend without breaking at temperatures as low as 50° below zero F. New plasticizers - dialkylphosphonostearates - are phosphorous containing compounds made from inedible animal fats.

(Announcement available. Free. Write U.S. Department of Agriculture, Room 403-A, Washington 25, D.C. for Rls. No. 2542-59)

() Spray Domes: Engineers have developed an air-inflated plastic film mold for "building" cocoon-shaped shelters known as "spray domes." Plastic mold, on which the resin and glass fiber compound is sprayed, can be made inexpensively in almost any shape and can also be deflated for re-use when the quick-drying resin-glass mixture sets. Surface of completed structure dries completely into a hard shell that will withstand two inches of ice and snow and 100 mph winds. Work is going forward on a portable spray kit expected to weigh about 200 pounds complete with plastic mold and spray gun.

(R&D by Rome Air Development Center, Air Research and Development Command, Griffis Air Force Base, N.Y.)

() Phototropy Research: Chemists working under U.S. Navy contract are studying the possibility of using the phenomenon of phototropy as a means of making an aircraft canopy opaque for protection of a bomber pilot against the brilliant flash of an atomic weapon. Materials are being developed which are designed to "black-out" in high intensity light, and then immediately return to normal.

(R&D by Midwest Research Institute, Kansas City, Mo.)

() Sandwich Construction: Studies by the NASA Langley Research Center indicate the proportions of truss-core and web-core sandwiches which give the minimum weight for carrying in-plane compressive loads. For lightly loaded sandwich plates, it is reported, the truss-core sandwich is less efficient than honeycomb. For higher-loading intensities, the truss-core is most efficient. It was found that the web-core is the least efficient of the three.

(Report available. 26 pages. Single copies free. Write Technical Information-BID, National Aeronautics and Space Administration, Washington 25, D.C. for NASA TN D-98)

() The Space Card: The Air Force Astro surveillance Laboratory has developed the space card, a printed-circuit card which is covered with a thin even film of hard resistive material. The card can be electrically excited to represent a two-dimensional plane. In one application, an aircraft was to be controlled in accordance with a predetermined flight pattern. By positioning a brush contact according to input information a command heading could be read off as a voltage. The technique has been successfully applied to navigational computers.

(Report available. 17 pages. 75 cents. Write OTS, U.S. Department of Commerce, Washington 25, D.C. for PB 151-524 - The Space Card: A Two-Dimensional Function Generator)

Publication Checklist

- () Defense Research, a summary report on basic scientific and astrodynamics research in the Department of Defense. Few details but some interesting conclusions and recommendations. 33 pages. Single copies free. (Write Committee on Science and Astronautics, New House Office Building, Washington 25, D.C. for Report No. 31)
- () Atlas-Polaris, the full text of unclassified testimony on the progress of the major missile programs. Also includes supplementary material on Cape Canaveral management contracts. 187 pages. Single copies free. (Write Committee on Science and Astronautics, New House Office Building, Washington 25, D.C. for Hearings No. 34)
- () Atomic Research, a new catalog-price list of all unclassified research reports sponsored by the Atomic Energy Commission. Lists some 4000 studies through July, 1959. Single copies free. (Write OTS, U.S. Department of Commerce, Washington 25, D.C. for Price List No. 32)
- () Stanford Accelerator, a do-it-yourself manual for building the Linear Electron Accelerator planned for construction at Stanford University. This book and \$105 million may be all you need. 649 pages. Single copies free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D.C. for Hearings - Stanford Accelerator Project)
- () Fluid Fuel Reactors, a "task force" report on the aqueous homogeneous, molten bismuth and molten salt reactor concepts. Invaluable reference aid in this field. 188 pages. \$1.75. (Write OTS, U.S. Department of Commerce, Washington 25, D.C. for Pub. TID - 8507)
- () Orbital Capsule Design, a technical report on the effects of water-landing impact on an orbital capsule of the Project Mercury type. Tests were made from the standpoint of occupant protection. 18 pages. Single copies free. (Write National Aeronautics and Space Administration, Attn: Code BID, 1520 H Street, N.W., Washington 25, D.C. for NASA Technical Note D-39)
- () Nuclear Safety, a new quarterly publication by the Atomic Energy Commission reviewing developments in reactor design, construction and operation; fabrication and reprocessing of reactor fuels; and handling of fissionable material including shipment and storage plus a number of special features. Single copies, 55 cents. Annual subscription, \$2. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C.)
- () Patents and Inventions, new pamphlet designed to provide guidance to inventors in deciding whether to apply for patents, in obtaining patent protection and promoting inventions. 15 cents. (Available at local U.S. Department of Commerce offices or from Superintendent of Documents, Government Printing Office, Washington 25, D.C. Ask for Patents and Inventions -- An Information Aid)
- () Dielectric Research, an excellent summary of programs in this field as carried out in the laboratories of the National Bureau of Standards, 19 pages. Single copies free. (Write National Bureau of Standards, Office of Technical Information, Washington 25, D.C. for Summary Tech Report - Dielectric Research)

